III.A.1 Correlations Between Calculation and Experiment

The primary means of producing the data in this section has been with the combination of the GAMTEC-II and HFN computer codes. The GAMTEC-II code was used to produce 18 neutron energy group cross-section sets which were then used in the HFN multigroup one-dimensional diffusion theory code to calculate critical sizes, extrapolation distances and material bucklings. A thorough analysis has been made by C. R. Richey[1] using this method to calculate the effective multiplication factor for critical experiments. A selection of these are produced below:

Geom.	Reflector	Pu g/l	% 240	Molarity	Calc. K_{eff}	Remarks
Sphere	Water	33.0	4.6	2.061	0.999	14 in. dia.
"	"	47.9	4.6	6.698	1.005	14 in. dia.
"	Bare	39.0	4.6	0.376	0.997	15.2 in. dia.
"	"	172.8	4.6	4.898	0.993	15.2 in. dia.
"	Water	26.33	0.54	0.806	0.998	14 in. dia.
"	"	28.63	0.54	2.553	0.997	14 in. dia.
"	"	73.0	4.6	0.165	1.001	11.2 in. dia.
"	"	140.0	4.6	2.238	1.001	11.2 in. dia.
"	"	268.0	4.6	1.084	1.001	11.2 in. dia.
Cyl.	"	44.7	1.5	2.058	0.9846	11.6 in. dia., ht.=12.28
"	"	45.45	1.5	2.094	0.9739	12.8 in. dia., ht.=10.34

(1) C. R. Richey, "Theoretical Analysis of Homogeneous Plutonium Critical Experiments," Nuclear Science and Engineering, January, 1968.

Richey found that as the height of the cylinders increased the agreement between theory and experiment became better, approaching a least-squares-fitted value of k_{eff} equal to 1.0086 for infinite cylinders.

The dimensions shown in Section III.A have been calculated with the GAMTEC II - HFN combination for k_{eff} equal to 1.00. The comparison with experiment shows that this can sometimes be slightly non-conservative. Dimensions which are less than critical with some degree of confidence can be obtained by reducing the calculated critical values to values equivalent to k_{eff} equal to 0.986 for spheres and 0.980 for infinite slabs and cylinders. (See page II.B.1-6) Critically favorable values can be obtained by adjusting the critical values by the appropriate safety factor given in Section I.C.

The buckling and extrapolation distance curves (Section A.10) are derived from GAMTEC II - HFN calculations and can be used for calculating general geometries other than those represented by the curves for the simple sphere, infinite cylinder and infinite slab. It might be noted that the use of the buckling and extrapolation distance curves for these simple geometries may give a somewhat smaller critical dimension than the geometry data shows. Since each geometry has a slightly different extrapolation distance for the same plutonium concentration, the graphing of all data would result in an unreadable mess of lines. Therefore, only the most limiting extrapolation distances were used in Section A.10 for each particular solution.